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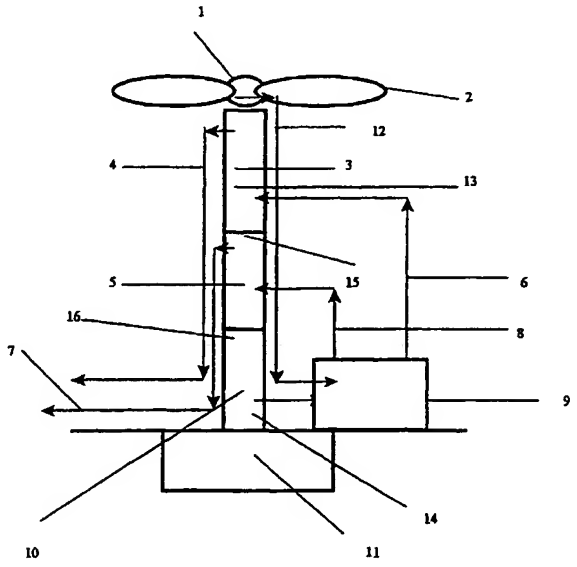
(54) Title: WIND POWERED ELECTRICAL GENERATOR



(57) Abstract: A method and apparatus used to produce and store hydrogen and/or gas derived from the electrolysis of water employing electric power obtained from wind energy. The method and apparatus combines the manufacture and storage of hydrogen (8) and/or oxygen (6) gases through the use of a water electrolysis system (9) with a wind power electric generator (1). This invention stores the energy derived from wind power (2) in the form of hydrogen (8) and/or oxygen (6) gas which is stored under pressure within the device.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WIND POWERED ELECTRIC GENERATOR

Field of the Invention:

The present invention relates in general to an apparatus and a method to improve and optimize the storage and use of useful forms of energy from wind power.

Background of the Invention:

In remote areas, which lack natural resources, except for wind, wind powered generators can be built in order to supply necessary electric power. Such generators are expensive to build and maintain, and are useful and cheaper than constructing distribution grids to such areas. Wind energy is generally intermittent and thus, methodologies and apparatus need to be established for storing the power generated. Historically, such apparatus and methodologies include batteries. Such methodologies and apparatus are expensive and storage capacity can be limited.

Accordingly, there is a need to provide for the generation and storage of power in remote locations in an economical and useful manner.

Summary of the Invention:

Wind power varies from site to site and is intermittent and fluctuating. The commercialization of technologies to generate electricity from wind power has depended on the conversion of this energy to

alternating electric current and the subsequent distribution of the electricity through electric utility distribution lines.

The present invention relates in general to a method to improve the cost and availability of useful energy in the form of stored hydrogen and/or oxygen gas derived by the electrolysis of water with electricity generated from wind power. This invention allows energy recovered from wind power in remote locations without adjacent electric utility lines to be economically harvested and stored by transforming the energy into hydrogen and/or oxygen gas under pressure for storage within the device. The storage of hydrogen and/or oxygen gas under pressure allows for the use of the energy at a time it is needed. The use of the energy can be in the form of heating fuel, fuel for an internal combustion engine or a fuel cell, and/or as an oxidant for medical or industrial use. The hydrogen and/or oxygen gases that are produced by the device are stored within a pressure chambers in the column or stand that supports the wind generator. The elimination of the need to distribute alternating current electric power correspondingly eliminates the need for power inversion as well as utility distribution lines. As the electrolysis unit can load-follow the quantity of power being produced, the device will be able to operate over a wide range of wind speeds. The need for expensive gear boxes is eliminated and the frequency of maintenance of the wind power generation system is drastically reduced.

An embodiment of the invention is used to produce and store hydrogen and/or oxygen gas derived from the electrolysis of water employing electric power obtained from wind energy. The manufacture of hydrogen and/or oxygen by electrolysis of water is well established and is typically accomplished in an electrolysis unit that employs chemical electrolytes or proton exchange membranes. The

production of electric power from wind energy is also well established. This invention combines the manufacture and storage of hydrogen and/or oxygen gases through the use of a water electrolysis system with a wind power electric generator. The storage of electrical energy derived from wind power has been expensive. As wind power is a fluctuating source of energy the production of electricity from this source is erratic. Typical wind power electric systems generate the electricity as direct current. This current is then inverted and dispatched to the power distribution system as alternating current. The storage of electrical energy in direct current form can be accomplished in batteries, but this method is expensive. This invention uses direct current power obtained from wind energy to produce the hydrogen and/or oxygen gases thereby eliminating the need for inverters. This invention stores the energy derived from wind power in the form of hydrogen and/or oxygen gas which is stored under pressure within the device. The manufacture of hydrogen and/or oxygen by electrolysis of water can be accomplished under a wide range of wind velocities, which is typical of the fluctuating conditions of a wind power source. The production rate of the hydrogen and/or oxygen gases is proportional to the wind velocity. Typical wind power electrical generators have expensive and complicated gearing systems to drive an electrical generator at a speed which is practical for electrical power generation. This invention simplifies and in some cases eliminates the need for such a expensive and maintenance prone gear box as the electrolysis unit is configured to be powered over a wide range of voltage and amperage conditions. The storage of hydrogen and/or oxygen gases, which are useful chemicals, eliminates the need for expensive battery storage. In

remote areas where no electrical power is available wind energy can be competitive with energy generation through internal combustion, except that wind energy is erratic and therefore unreliable. Further, it has traditionally been very expensive to store the energy in batteries for use during periods when the wind velocity is diminished. This invention makes wind powered energy generation possible in such remote areas. The hydrogen gas can be used as a fuel for its heating value, as a fuel to power an internal combustion engine to drive a variety of loads, or as the feed gas to a fuel cell to generate electricity. The oxygen gas can be used for a variety of medical or industrial applications. In remote areas the oxygen gas will have considerable value for medical or industrial applications. The size of units can be small or large. Wind power generators as small as one kW and as large as five hundred kW are available. Water electrolysers that match this range of power output are available today. The size of the system will be limited by the size of wind turbines that are used to convert the kinetic energy in the wind to drive the electric power generator. It is quite likely that wind powered electrical generators with capacities of one thousand kW or larger can be available on the marketplace. This invention is capable of matching this large level of power generation. Proton exchange membrane electrolysis units are capable of producing hydrogen and oxygen gases at highly elevated pressure. Newer electrolyte based electrolysis units are also capable of producing these gases at elevated pressure. The storage of the hydrogen and/or oxygen gases can be performed at the exit pressure of the electrolysis unit or their pressure can be further elevated using compressors. The invention makes use of the pole, stand or column used to elevate and support the wind turbine and electric generator for the additional

purpose of storing the water, electrolyte, hydrogen and/or oxygen that are part of the electrolysis process further, thereby reducing the cost of the unit by eliminating addition storage vessels. That is to say, that at elevated pressure, more gases can be stored in less volume. This makes advantageous use of the structural integrity of the column designed to support the wind turbine. Therefore, the invention is an economic apparatus and method for producing useful products with chemical and energy potential in a way that has not been previously done.

An object of the present invention is to provide an apparatus and method for storing wind energy in a usable form.

Accordingly, an object of the invention is an apparatus and method for manufacturing and storing hydrogen and/or oxygen gas derived from electrolysis of water where the energy source for the electricity is wind power.

Another object of the invention is an apparatus and method for producing and storing useful energy in remote location from wind powered electrical generation systems.

A further object of the invention is an apparatus and method for manufacturing and storing oxygen gas for use in medical and/or industrial applications in remote areas.

Brief Description of the Figures:

FIG. 1 is a schematic flow chart and elevation view of the embodiment of the invention showing the process and apparatus for generating direct current electricity from wind power together with the electrolysis of water to produce hydrogen and/or oxygen gases stored under pressure within the embodiment.

Detailed Description of the Preferred Embodiment:

The present invention is based on the method and apparatus embodied in a wind powered direct current electric generator with a water electrolysis unit to produce and store hydrogen and/or oxygen gases within the embodiment. This allows for the generation and storage of useful energy particularly in remote areas where no electrical utility distribution lines are installed. An embodiment of the invention is generally denoted by elements 1, 2, 3, 5, 9, 10 and 13 as illustrated in FIG. 1.

In FIG. 1 during periods when wind is blowing the blades 2 of the device spin to drive the direct current generator 1 to generate electric power in the form of direct current which is conducted by the wires 12 to the water electrolysis unit 9. The direct current conducted in wires 12 causes water 14 pumped from the chamber 10 (within the supporting column 13 supporting the generator 1 and blades 2) into the electrolysis unit 9 to be converted to hydrogen gas 8 and oxygen gas 6. One or both of hydrogen and oxygen may be stored. The non-stored gas, if any, could be vented. The water 14 is pumped under positive pressure such that hydrogen gas 8 and oxygen gas 6 are formed under pressure and the hydrogen gas 8 is stored in pressure chamber 5 within the supporting column 13. The oxygen gas 6 is stored within pressure chamber 3 of the supporting column 13. The supporting column 13 is embedded in a concrete footing 11 in order for the device to remain vertical. The column 13 is made of tubular steel capable of holding the pressure of the water 14, hydrogen gas 8 and oxygen gas 6 within their respective chambers 10, 5 and 3. Accordingly, economies are realized as the column 13 required to hold generator 1 in a wind is useful for storage of water and the generated gases of hydrogen and/or oxygen. The chambers are separating by steel

separation disks 15 and 16 to prevent the mixing of the water 14, oxygen 6 and hydrogen 8.

Hydrogen is withdrawn from chamber 3 by pipe 4. Oxygen is drawn from chamber 5 by pipe 7.

Industrial Applicability:

The invention embodies a new and useful method and apparatus for generating power remotely from a power grid and storing energy in the form of hydrogen and/or oxygen.

Other features, aspects and objects of the invention can be obtained from a review of the figures and the claims.

It is to be understood that other embodiments of the invention can be developed and fall within the spirit and scope of the invention and claims.

What is claimed is:

1. A method for storing power generated from wind including the steps of:

generating power from wind;

using the power in order to generate oxygen and hydrogen from the electrolysis of water; and

storing at least one of oxygen and hydrogen for use.

2. The method of claim 1 wherein:

said generating step is accomplished by allowing wind to turn blades which are associated with a generator for generating DC power.

3. The method of claim 1 wherein:

said generating step uses a generator mounted atop of a housing; and

said storing step uses the housing to store at least one of oxygen and hydrogen.

4. The method of claim 2 wherein:

said using step uses the DC power for the electrolysis of water.

5. The method of claim 3 wherein preparatory to the storing step is the step of:

building the housing to support a generator and incorporating into the housing at least one pressure vessel in order to store one of oxygen and hydrogen.

6. The method of claim 1 including the step of:

storing water preparatory to the generation of oxygen and hydrogen from the water.

7. The method of claim 5 wherein:

said building step includes incorporating into said housing a vessel to store water for the electrolysis of water.

8. The method of claim 6 including the step of:

pumping the water under pressure into a unit for performing the electrolysis of water.

9. The method of claim 1 wherein:

said using step generates oxygen and hydrogen under pressure.

10. The method of claim 1 wherein:

said using step generates oxygen and hydrogen under pressure from water which is under pressure.

11. The method of claim 1 wherein:

the generating, using and storing steps are performed using a wind turbine located in a remote locate which is distant from a power grid.

12. The method of claim 1 wherein said storing step is performed in a tubular steel column supported on top of a concrete footing.

13. An apparatus for storing power generated from the wind comprising:

a generator powered by the wind;

a unit that is powered by the generator and that generates oxygen and hydrogen from the electrolysis of water; and

a storage unit that stores at least one of the oxygen and the hydrogen.

14. The apparatus of claim 13 wherein:

said generator is used to generate DC power.

15. The apparatus of claim 14 wherein:

said generated DC power is used to generate oxygen and hydrogen from the electrolysis of water.

16. The apparatus of claim 13 including:

a housing atop which said generator is mounted; and

said housing includes said storage unit.

17. The apparatus of claim 15 including:

a unit that stores water used for the electrolysis of water; and

said housing includes said water storage unit.

18. The apparatus of claim 16 wherein:

said housing is comprised of a column of tubular steel and supported by a concrete footing.

19. The apparatus of claim 15 including:

a housing atop which said generator is mounted;

said storage unit includes a first pressure vessel included in said housing; and

a water storage unit which includes a second vessel included in said housing.

20. The apparatus of claim 19 wherein:

said first storage unit is for storing one of oxygen and hydrogen; and

a third pressure vessel included in said housing, said third pressure vessel for storing the other of oxygen and hydrogen.

21. An apparatus for storing power generated from the wind comprising:

a generator powered by the wind;

said generator mounted atop of a housing

a unit that is powered by the generator and that generates oxygen and hydrogen from the electrolysis of water;

a first storage unit that stores at least one of the oxygen and the hydrogen;

a second storage unit that stores water; and

said first and second storage units incorporated in said housing.

22. The apparatus of claim 21 wherein:

said first storage unit is a first pressure vessel for holding said at least on of oxygen and hydrogen; and

said second storage unit is a second vessel capable of holding the water.

23. The apparatus of claim 21 wherein:
said housing is a tubular column.

24. The apparatus of claim 21wherein:
said housing is made out of steel.

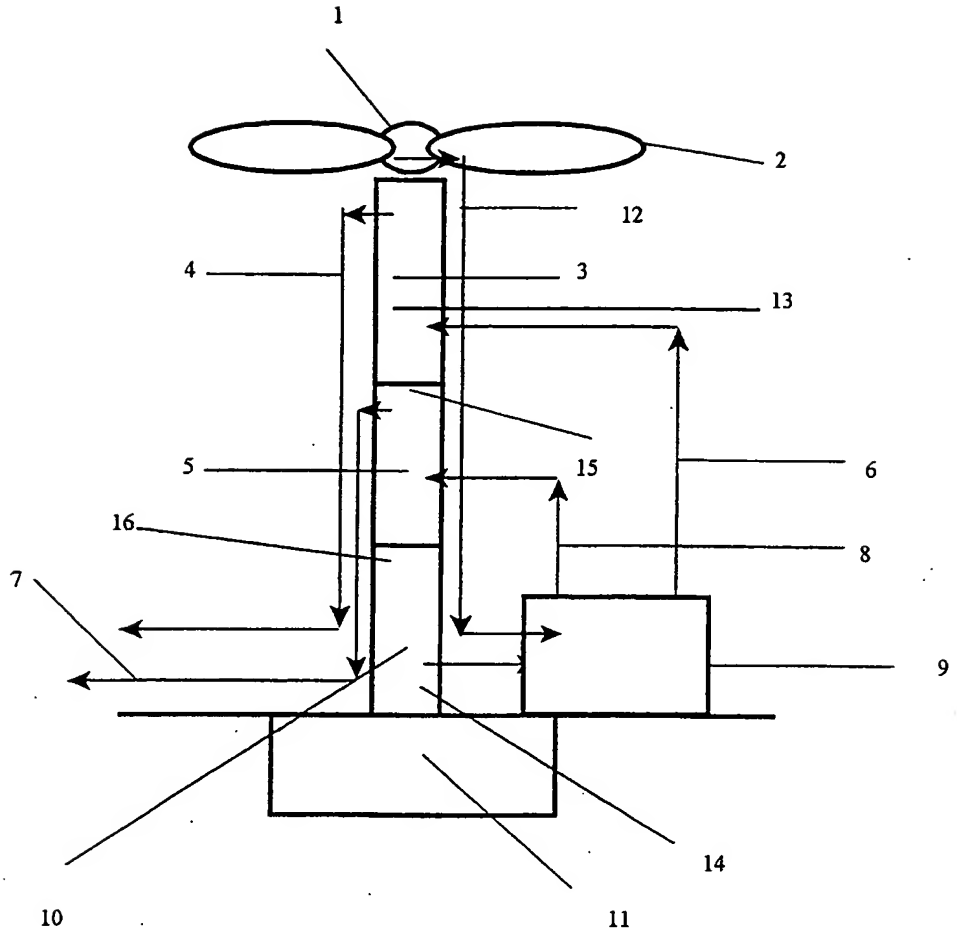

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/41601

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :F03B 13/00, 13/10, 13/12; H02P 9/04
US CL :290/42,43,44,53,54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 290/42,43,44,53,54

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	USP 5,592,028 A (PRICHARD) 07 JANUARY 1997, (07/01/97) ENTIRE DOCUMENT.	1-24
Y	US 4,335,093 A (SALOMON) 15 JUNE 1982, (15/06/82) ENTIRE DOCUMENT.	1-24
Y	US 4,274,010 A (LAWSON-TANCRED) 16 JUNE 1981, (16/06/81) ENTIRE DOCUMENT.	1-24
Y	US 4,211,076 A (GRANDE) 08 JULY 1980, (08/06/80) ENTIRE DOCUMENT.	1-24
Y	US 4,184,084 A (CREHORE) 15 JANUARY 1980, (15/01/80) ENTIRE DOCUMENT.	1-24

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

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